CLAIMS:

1. An optical scanning device for scanning an information layer of an optical record carrier, the information layer being covered by a transparent layer of thickness t_d and refractive index n_d, the device comprising a radiation source for generating a radiation beam and an objective system for converging the radiation beam on the information layer, the objective system being characterised in comprising a lens comprising a synthetic resin on a substrate, the total thickness t of the lens satisfying the condition:

$$0.8 < \frac{t - 1.1\phi + 1.1}{1.18 - 2.28\left[FWD + \frac{t_d}{n_d}\right]} < 1.2$$

where FWD + $t_d/n_d<0.51$, and FWD is the free working distance between the lens and carrier and ϕ is the entrance pupil diameter of the lens, where t, t_d, ϕ and FWD are expressed in millimetres.

2. A device as claimed in claim 1, wherein the total thickness t of the lens satisfies the condition:

$$0.9 < \frac{t - 1.1\phi + 1.1}{1.18 - 2.28\left[FWD + \frac{t_d}{n_d}\right]} < 1.1$$

3. A device as claimed in claim 1, wherein the refractive index n of the substrate satisfies the condition:

$$-0.05 < n - 2.49 + 2.79\left(\frac{FWD + \frac{t_d}{n_d}}{F}\right) - 2.28\left(\frac{FWD + \frac{t_d}{n_d}}{F}\right)^2 < 0.05$$

where F is the focal length of the lens.

4. A device as claimed in claim 1, wherein the Abbe number of the substrate is greater than 40.

5. A device as claimed in claim 1, wherein the surface of the lens arranged to face the record carrier has a best fit radius satisfying the condition:

$$R > 5\frac{n_r - 1}{NA}\phi$$

where ϕ is the entrance pupil diameter of the lens, NA is the numerical aperture of the lens, and n_r is the refractive index of the resin.

6. A device as claimed in claim 1, wherein the normalised optical power P of the surface of the lens arranged to face the record carrier satisfies the condition:

$$-0.1 < P < 0.1$$

7. A lens system comprising at least one lens for converging a radiation beam on an information layer of an optical record carrier, the information layer being covered by a transparent layer of thickness t_d and refractive index n_d, the lens system being characterised in comprising a lens comprising a synthetic resin on a substrate, the total thickness t of the lens satisfying the condition:

$$0.8 < \frac{t - 1.1\phi + 1.1}{1.18 - 2.28\left[FWD + \frac{t_d}{n_d}\right]} < 1.2$$

where $FWD + t_d/n_d < 0.51$, and FWD is the free working distance between the lens and carrier and ϕ is the entrance pupil diameter of the lens, where t, t_d, ϕ and FWD are expressed in millimetres.

8. A lens system as claimed in claim 7, wherein said substrate is glass.

9. A method for manufacturing a lens system comprising at least one lens formed of a synthetic resin on a substrate, for converging a radiation beam on an information layer of an optical record carrier, the information layer being covered by a transparent layer of thickness t_d and refractive index n_d, the method comprising the steps of:

forming the lens, the total thickness t of the lens satisfying the condition:

$$0.8 < \frac{t - 1.1\phi + 1.1}{1.18 - 2.28\left[FWD + \frac{t_d}{n_d}\right]} < 1.2$$

where FWD + $t_d/n_d<0.51$, and FWD is the free working distance between the lens and carrier and ϕ is the entrance pupil diameter of the lens, where t, t_d, ϕ and FWD are expressed in millimetres.

10. A method as claimed in claim 9, further comprising the step of forming an aspherical surface on said substrate by applying a synthetic resin to a surface of said substrate.

11. A method of manufacturing an optical scanning device for scanning an information layer of an optical record carrier, the information layer being covered by a transparent layer of thickness t_d and refractive index n_d, the method comprising the steps of:

providing a radiation source for generating a radiation beam;

providing a lens system for converging the radiation beam on the information layer, the lens system being characterised in comprising a lens comprising a synthetic resin on a substrate, the total thickness t of the lens satisfying the condition:

$$0.8<\frac{t-1.1\phi+1.1}{1.18-2.28\left[FWD+\frac{t_d}{n_d}\right]}<1.2$$

where FWD + $t_d/n_d<0.51$, and FWD is the free working distance between the lens and carrier and ϕ is the entrance pupil diameter of the lens, where t, t_d, ϕ and FWD are expressed in millimetres.